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(71) Applicant (*for all designated States except US*): **POLY-METERS RESPONSE INTERNATIONAL LIMITED** [GB/GB]; PRI House, Moorside Road, Winchester, Hampshire SO23 7RX (GB).

(72) Inventor; and

(75) Inventor/Applicant (*for US only*): **GHOSH, Kaushik** [IN/IN]; 71 Technocrat Society, Bedla Road, PO Badgaon, Udairpur-313011 (IN).

(74) Agent: **CRAWFORD, Andrew, B.**; A.A. Thornton & Co., 235 High Holborn, London WC1V 7LE (GB).

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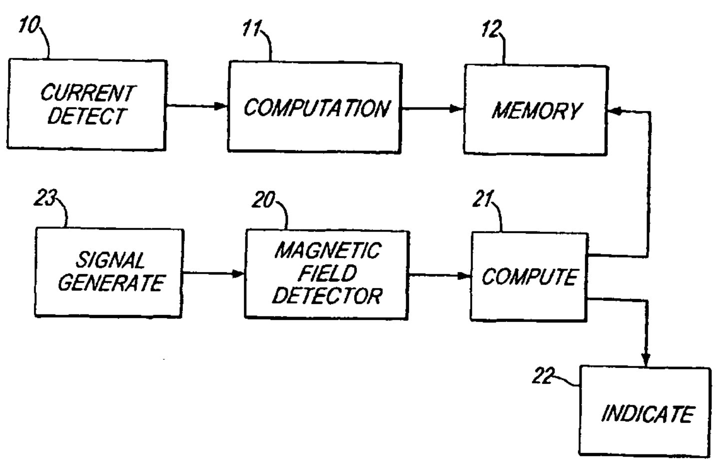
(54) Title: APPARATUS FOR DETECTING TAMPERING WITH A UTILITY METER



(57) Abstract: An electronic utility meter to monitor magnetic fields in utility meters and to indicate the presence of abnormally large magnetic fields. The meter comprises means for detecting consumption of a utility, means for indicating the result of the detection and means for detecting the presence of a magnetic field originating outside the meter. Preferably, the magnetic field detection means includes a detection circuit, which includes an inductance in the form of a coil wound around a ferrite core.

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APPARATUS FOR DETECTING TAMPERING WITH A UTILITY METER

The present invention relates to utility meters and more particularly to apparatus for detecting tampering with such meters.

Meters for measuring consumption of gas and electricity are well known and many rely on electromagnetic or electronic principles. Such meters can be tampered with by applying magnets to the meter in order to reduce or actually stop the registration of consumption. This has resulted in proposals to provide the meters or at least the active part of such meters with magnetic shields. However, in response to this, persons wishing to tamper with meters have resorted to using stronger and stronger magnets.

It is an object of the present invention to monitor magnetic fields in utility meters and to indicate the presence of abnormally large magnetic fields.

When an abnormally high magnetic field is detected, this fact is preferably recorded by the meter in some convenient fashion, e.g. by noting the date and time of the occurrence. Likewise, the removal of the abnormally high magnetic field can also be detected and recorded. This enables the utility supplier to take appropriate steps which may include increasing the cost of the supply of the utility during such periods.

Preferably, the apparatus utilises a ferrite core provided with a coil which is used to provide a sense signal which can be evaluated.

In order that the present invention be more readily understood, an embodiment thereof will now be described with reference to the accompanying drawings, in which:

Fig 1. shows a block diagram of a utility meter provided with apparatus according to the present invention; and

Fig 2. shows a diagrammatic representation of apparatus according to the present invention.

The preferred embodiment of the present invention is an electricity meter which may be either a conventional electromagnetic meter or a more

modern electronic meter which utilises a current transformer in order to detect consumption of electricity. It will be appreciated that this is simply an example of a utility which could be metered and that the present invention is capable of being utilised with different types of meter for recording the consumption of different flowing substances.

Referring to Fig 1., this shows a block diagram of an electricity meter where it is assumed it is an electronic meter. Electronic meters differ from traditional electromechanical meters in that electronic meters do not use a meter system with a disc which rotates and which is driven at a rate dependent upon the current drawn. Instead, electronic meters measure electricity consumption by detecting current utilising a current detector 10 in the form of a current transformer whose output is fed to a computation section which is preferably constituted by a microprocessor 11. The result of the computation is then recorded and periodically stored in a memory 12. In addition, the electronic meter may be provided with communication means well known in the art to allow for the meter to be read remotely through a communication link. Thus far the meter is standard.

However, it is known that the current detection can be affected by the presence of a high external magnetic field. The present invention is designed to detect the presence of such a field and to cause the presence of such a field to be recorded by the meter and preferably also to be indicated to the user in the hope of deterring tampering with the meter. The indication can be any suitable visible and/or audible indication such as flashing a display or flashing a red light. It is preferred to record the commencement and cessation of the existence of the abnormally high magnetic field so that the utility provider can take appropriate steps.

The presently preferred arrangement for detecting the magnetic field is represented in Fig 1. by the magnetic field detector 20 whose output is fed to a computation circuit 21. The circuit 21 includes a comparator for comparing the output from the magnetic field detector with a threshold level which is chosen

to indicate the presence of the abnormally high magnetic field. The circuit 21 outputs a signal to the memory 12 and records the date and time of the commencement and cessation of the existence of the abnormally high magnetic field. Additionally, if desired, the circuit 21 also triggers an indicator 22.

If one now refers to Fig 2., this shows the preferred arrangement for detecting magnetic fields. It consists of an inductance L constituted by a ferrite core provided with a coil. One end of the coil is earthed via a resistor and this end constitutes the output from the detector. The other end of the coil constitutes the input to the detector and is fed with a waveform from a signal generator 23 which is shown in Fig1.. In this example, the signal generator outputs a square wave which will normally result in the output of the coil being a somewhat saw toothed waveform due to the inductance L. The slopes of the saw tooth are determined by the inductance value of the coil L and the ferrite core and coil are arranged to saturate at a predetermined level of external magnetic field. Saturation reduces the value of the inductance quite substantially and this in turn increases the rate of change of the slope of the current output waveform so that during saturation the square wave is more accurately transferred from the input to the output. The output from the coil is fed to an average value determining circuit in the computation circuit 21 and it will be appreciated that the average value under normal conditions will be much less than the average value of the output in the presence of an abnormally high magnetic field which saturates the coil. The output of the average value circuit is then evaluated. This can be readily achieved by a comparator circuit for a simple comparison with a preset threshold level.

It is preferred that when a meter is constructed incorporating a magnetic field detector circuit, on initial power up of the meter following manufacture, the ambient magnetic field can be registered and this will provide a datum level to which an offset indicative of the abnormally high magnetic field will be added.

It will be appreciated that the above detector could be utilised with a magnetic shield for the meter. If the magnetic field detector were located outside the shield, then this would result in someone wishing to tamper with the meter would have to utilise a sufficiently high magnetic field which would inevitably be detected by detector circuit.

Additionally, it will be appreciated that the detector coil provided with the ferrite core will be able to detect both alternating and direct magnetic fields and that because ferrite materials are easy to form, the ferrite core can be made to detect omni-directional magnetic fields.

Various modifications to the circuitry are envisaged and various components of the meter may be shared with the magnetic field detector. For example, rather than using a comparator at threshold level, the microprocessor may be utilised to evaluate the output of the detector. This may require a separate A/D channel being available. Also, rather than having a separate detector core, it is possible to modify the current transformer or power supply transformer for an electronic meter by adding an extra winding which will be supplied with the detection waveform. This, however, may require some additional computation for the actual meter reading so as to avoid false readings due to the presence of the detection waveform.

CLAIMS:

1. An electronic utility meter comprising means for detecting consumption of a utility means for indicating the results of the detection and means for detecting the presence of a magnetic field originating outside the meter wherein the magnetic field detection means includes a detection circuit including an inductance.

2. An electronic utility meter according to claim 1 and comprising memory means for storing the occurrence of the detection of the magnetic field.

3. An electronic utility meter according to claim 2, and wherein the magnetic field detection means is used to indicate the removal to the magnetic field.

4. An electronic utility meter according to claim 1, and comprising a real time clock and memory means for storing the date and/or time during which the detection of the magnetic field has occurred.

5. An electronic utility meter according to any one of the preceding claims, wherein the magnetic field detection means includes a waveform generator applying a detection waveform to the detection circuit.

6. An electronic utility meter according to claim 5, wherein the inductance is in the form of a coil wound around a ferrite core.

7. An electronic utility meter substantially as hereinbefore described with reference to the accompanying drawings.

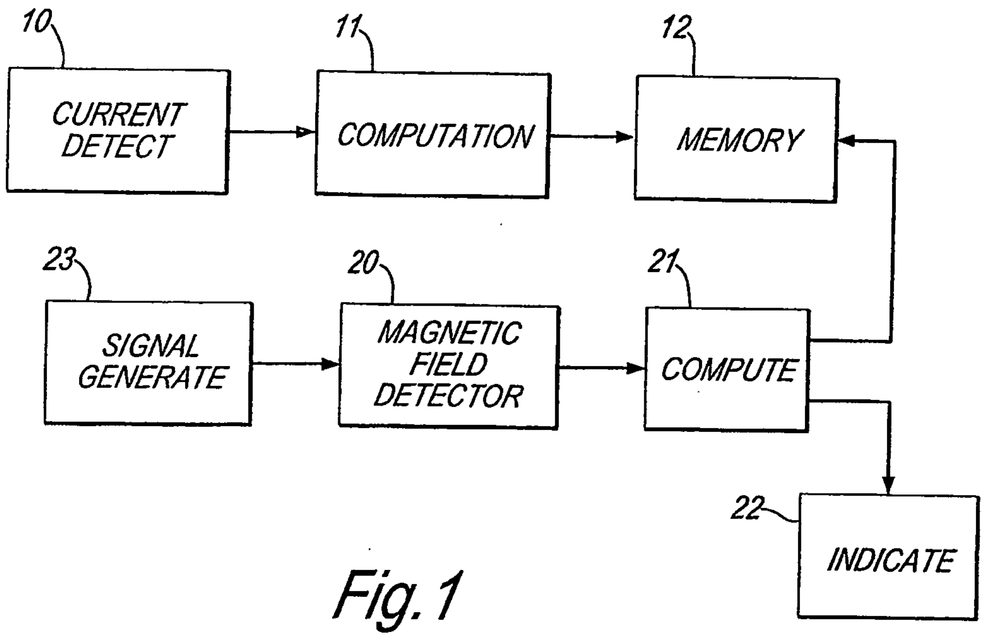
10
CURRENT DETECT
11
COMPUTATION
12
MEMORY
23
SIGNAL GENERATE
20
MAGNETIC FIELD DETECTOR
21
COMPUTE
22
INDICATE

Fig.1

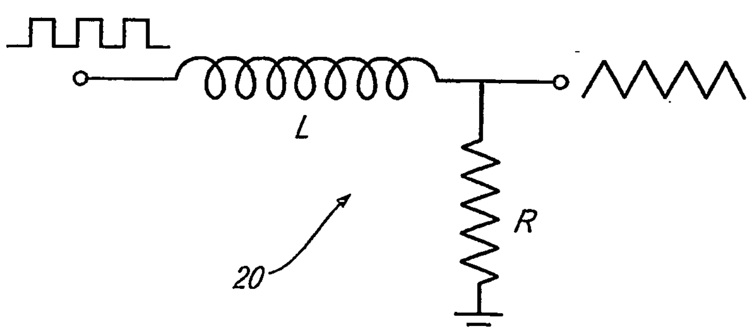
L
R
20

Fig.2

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International Application No
PCT/GB 03/03371

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G01R11/24

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 G01R

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ, INSPEC, IBM-TDB

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 2 347 225 A (C K ELECTRONICS SDN BHD) 30 August 2000 (2000-08-30) page 16, last paragraph; claim 2; figure 17 page 18, paragraph 2 -page 19, paragraph 1 figures 1,14,18	1-7
A	DE 27 28 896 A (LANDIS & GYR AG) 7 December 1978 (1978-12-07) page 5, paragraph 2 page 6, paragraph 4 figure 2A	1,5
A	WO 89 10570 A (OMEGA ELECTRIC LTD) 2 November 1989 (1989-11-02) page 1, line 1-7 figures 1,2	1

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Lopez-Carrasco, A

INTERNATIONAL SEARCH REPORT

ıtion on patent family members

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